# (WO/2004/044402) THERMAL DEVICE FOR THE REGULATION OF THE INTAKE AIR FOR AN ENGINE AND THE EXHAUST GAS RECIRCULATED EMITTED SAID BY ENGINE.



Note: OCR Text

Device temperature of the air intake of an engine and exhaust recirculés issued by this engine The present invention relates to a temperature of the air intake of an engine and exhaust gases emitted by recirculés this engine.

It applies in particular to the temperature of a mixture of admission of an internal combustion engine supercharged connected to a line of exhaust fitted with a particulate filter.

You want to cool the intake air with an engine especially when the latter is supercharged through a set turbo-compressor equipped, on the one hand, a turbine driven by exhaust gas engine, agencée downstream of the engine, and on the other hand, an air compressor admission arranged upstream of the engine.

Indeed, the intake air engine is warming up in the compressor, must be cooled to exit from the compressor to maximize engine performance and minimize emissions of pollutants. Indeed, lowering the temperature of the air intake increases the density of this air. Increasing the density increases the amount of air allowed into the cylinders and engine power.

You want to warm the air intake of an engine especially when the latter is connected to a line of exhaust fitted with a particulate filter. The filter must be refreshed periodically to remove soot particles that accumulate. Regeneration is achieved by heating the intake air to a temperature sufficient to cause combustion particles of soot.

In some types of engine, a portion of the exhaust is furnished with air traffic admission. The exhaust gases are commonly called exhaust recirculés EGR (Exhaust Gas Recycling). The latter, mixed with air intake through appropriate means, are diverted to the engine.

You want to regulate the temperature of exhaust gas recirculés aiming in particular to lower the temperature of these gases before be mixed with the air intake and returned to the engine.

It is already in the state of the art device temperature of the air intake of an internal combustion engine of motor vehicle, forming a first fluid calo-regulate, and exhaust gases recirculés emitted by the engine, forming a second fluid calo-regulate, type, including: -- The first means of exchanging heat between a liquid coolant and intake air, and - seconds means of exchanging heat between a liquid coolant and exhaust recirculés.

Usually, the cooling of the intake air is directed by a heat exchanger air-intake air, placed in front of a vehicle.

In addition, the heating of the intake air is directed by a heat exchanger coolant / air intake, placed in front of the vehicle. This exchanger coolant / air intake is part of the primary means of heat exchange between a liquid coolant and intake air, identified above.

Finally, cooling exhaust recirculés is directed by a heat exchanger liquid heat / gas Exhaust recirculés, adjacent to the engine. This exchanger coolant / exhaust recirculés is therefore part of the latter means of exchanging heat between a liquid coolant and exhaust recirculés, identified above.

The temperature of the air intake and exhaust recirculés is therefore carried out using three interchanges and multiple ways to control flow of fluids calo-regulated associated with these interchanges.

The number of interchanges and their locations business (front, an area contiguous to the engine) gives the device temperature relative compiexity including imposing a line of intake air relatively long lead to charges consequent losses.

Moreover, the means of regulating flow of fluids calo-do usually regulated the flow of intake air only through one or other of the two heat exchangers air-intake air and liquid heat / air admission empchant a simultaneous influence of these two interchanges on the intake air.

The invention is a purpose to optimize the structure and operation of a device temperature of the type mentioned above.

To that end, the invention relates to a device temperature of the air intake of an internal combustion engine of motor vehicle, forming a first fluid calo-regulate, and exhaust gases recirculés emitted by the engine, forming a second fluid calo-regulate the type cited above, wherein a heat exchanger main muni: -- the first and second parts, respectively, forming the first and second means of exchanging heat and -- Means of channelling coolant for heat exchange with at least one of two fluids in calo-regulate containing at least one channel of movement of fluid, common to both parties, in exchange heat with the air intake and Exhaust recirculés.

The invention makes it possible to simplify the structure of the device temperature particularly because the heat exchanger includes the first principal means of heat exchange between the coolant and air intake and the latter means of exchanging heat between the coolant and exhaust recirculés. This simplification, which translates into a lower cost device temperature, facilitates the integration of the adjustment mechanism in the vehicle. The main intersection may be advantageously arranged at the entrance to the inlet of the engine.

Thanks to the invention, the line of intake air is relatively short so that losses are low load. The conduct of the vehicle is more enjoyable because of an optimization engine performance resulting in effective occasions.

The simplification of the structure of the device temperature simplifies all the means of regulating flow of fluids calo-calo-regulator and regulated.

As a result, emissions of polluting engines, including diesel type, (HC, CO, <BR> <BR> NOx, particulate matter, and so on. ) Are reduced by optimizing the composition, flow and the temperature of the mixture admission including the intake air and gases recirculés.

Preferably, the means of channelling coolant are connected to a coolant circuit said cold and a fluid-cooled hot said.

Thus, the main interchange allows both cool than warm air admission by circulation of liquid coolant in the main intersection at a suitable temperature.

Next other optional features of this device : -- Inflows air intake and exhaust recirculés are significant parallels in the first and second parts of the heat exchanger - ways of channelling coolant include at least one channel of movement of liquid coolant, said separate channel, covering only the first part, heat with the air intake; -- the first part of the main heat exchanger is connected to an air intake including means of distribution of intake air, arranged upstream of the main intersection, intended to spread the intake air between the first and second areas of the first part of the main intersection in which extend respectively channels common and separate liquid-cooled; -- coolant is put into circulation circuit in the cold by a pump - A heat exchanger liquid heat / air, said exchanger cold, is connected to the circuit coolant cold; -- hot circuit is connected only to channel common circulation fluid; -- hot circuit is connected to a heat exchanger liquid / air, said exchanger hot, preferably as part of a circuit coolant internal combustion engine; - means of channelling coolant circuits are connected to the cold and warm Using a valve at three distribution channels including a first track connected to the exit channel, a second track connected to the entrance of the cold exchanger and a third way connected to the entry of intersection hot; -- second part of the main intersection is connected to a circuit exhaust recirculés including ways to bypass this second part of the main intersection; -- circuit exhaust recirculés includes means of distribution of gas between the second part of the main intersection and means of derivation thereof; - means of distribution of exhaust gas recirculés include a valve division to three lanes with a first track connected to the exhaust, a second track connected to the entrance of the second part of the main intersection and a third way connected to the means of diversion of the second part the main intersection - the heat exchanger includes principal means of a pipeline fluid said very cold for heat

exchange with at least one of fluid to regulate among calo-air intake and exhaust recirculés; -- Means of channelling of very cold fluid are connected to a circuit fluid said very cold thermally coupled to a heat pump; -- Air Admission is led to a pressure higher than atmospheric pressure, through the heat exchanger leading a series turbo-compressor equipped with a turbine driven by exhaust fumes of internal combustion engine; -- internal combustion engine, for example type Diesel, is connected to an exhaust system equipped with a particulate filter; -- coolant is a mixture of water and antifreeze.

The invention will be better understood from reading the description that will follow, given only as an example and made reference to the drawings in which: - Figures 1 to 6 are schematic views of an internal combustion engine connected to means forming upstream circuit air intake, fitted with a device temperature according to a first embodiment of the invention, and means downstream line forming exhaust; -- Figure 7 is a similar view in Figure 1 showing a device temperature according to a second embodiment of the invention.

It was on the figures represented an internal combustion engine 10 of motor vehicle, for example type Diesel, connected to upstream means forming a circuit 12 air intake into the engine 10 and downstream means forming a circuit 'exhaust 14.

The engine is supercharged 10 through a series turbo-compressor equipped, on the one hand, a 16 turbine driven by exhaust gases from the engine 10, arranged downstream of the engine 10 in the exhaust 14 And, secondly, an air compressor 18 admission arranged upstream engine 10 in the circuit 12 air intake. The 16 turbine and compressor 18 are coupled rotating them so famous in itself.

The exhaust 14 is equipped with a particulate filter classic 20.

The admission of 12 circuit is connected to the engine 10 by an inlet 22 forming the downstream end of this circuit 12.

Upstream compressor 18, the circuit admission includes an air filter classic 23.

The exhaust 14 is connected to the engine 10 by an exhaust manifold 24 forming the upper end of this circuit 14.

It was also shown in Figure 1 circuit 26 exhaust recirculés involving upstream end connected to the outlet of the exhaust manifold 24 and a downstream end connected to the entrance to the inlet 22.

The temperature of the air intake and exhaust recirculés are regulated through a temperature of 28 according to the invention two modes of execution are shown in Figures 1 to 6, on the one hand , And 7, on the other. it should be noted that these figures are similar elements designated by references identical.

In what follows, two bodies are called coupled heat between them when they exchange of heat between them through a heat exchanger appropriate.

Reference is made below the device temperature 28 as the first embodiment of the invention shown in figures 1 to 6.

The temperature control device 28 includes a heat exchanger main liquid 30 heat / fluid Calo-to regulate.

Preferably, the liquid coolant is a mixture of water and antifreeze.

The main heat exchanger 30 includes a first 30A forming part of the primary means of heat exchange between the coolant and intake air (the first fluid calo-regulate). The main heat exchanger 30 also includes a second section 30B forming seconds means of heat exchange between the coolant and exhaust recirculés (second fluid calo-regulate).

The first 30A and second 30B parts of the main intersection 30 respectively are connected to circuits intake air 12 and gas recirculés 26.

In the main intersection 30, both air flow intake and exhaust recirculés are separated. The possible mix of the intake air with exhaust fumes recirculés is, downstream of the main intersection 28, at the downstream end of the 26 circuit connected to the entrance to the inlet 22 .

The heat exchanger still includes 30 principal means of channelling of liquid coolant for heat exchange with the air intake and / or exhaust gases recirculés.

These include ways of channelling at least one channel 32 of movement of fluid, common to both sides 30A, 30B. The coolant flowing through the common channel 32 and therefore likely to be in heat exchange with both air intake and exhaust recirculés. More specifically, heat of the liquid coolant, moving upstream to downstream in the common channel 32, which is different back and forth between the first and second 30A parts 30B of the main intersection 30, are both the intake air and with the exhaust gases recirculés.

The means of channelling coolant also include at least one channel 34 of fluid flow, said separate channel, covering only the first part 30A of the main intersection 30. The coolant circulating in the separate channel 34 is likely to be in heat exchange with the air intake.

It should be noted that, preferably, the flow of air intake and exhaust recirculés circulating in the two parts 30A, 30B of the main intersection 30 so substantially parallel.

In order to optimize the temperature of fluids to regulate calo-crossing the main intersection 30, the circuit 12 admission includes 36 means for sharing the intake air arranged upstream of the main intersection 30 compared the sense of movement of the intake air. These means of distribution 36, including for example an articulated flap 38, are intended to spread the intake air between the first Z1 and Z2 second areas of the first section 30A of the main intersection 30.

The common channel 32 of coolant spreads mainly in the first zone Z1. The separate channel 34 of coolant spreads mainly in the second zone Z2. Where appropriate, the two areas Z1, Z2 can be defined by physical means of separation.

The means of channelling coolant, including the common channels 32 and separated 34, are connected to a circuit coolant circuit said cold 40. This circuit is cold 40 separate circuit engine coolant heat exchanger 10 A classic coolant / air, said cold exchanger 42, is connected to the circuit cold 40. This cold exchanger 42 is arranged, for example, in front of the vehicle.

The fluid is put into circulation in the cold circuit 40 by a pump 44 prepared, for example, downstream of the cold exchanger 42.

It should be noted that the common channels 32 and separated 34 are connected in parallel to the circuit cold 40.

The means of channelling coolant are also connected, at least in part, a fluid coolant circuit said hot 46.

Thus, the hot 46 circuit is connected only to the common channel 32 of movement of liquid coolant.

The circuit hot 46 is connected to a heat exchanger conventional liquid / air heat exchanger said 48, forming part of a circuit of engine coolant 10.

The means of channelling coolant circuit are connected to 40 cold and hot 46 with a valve 50 to three distribution channels. This valve division 50 includes a first track 50A tube of the common channel 32, a second track 50B connected to the entrance of the cold exchanger 42 and a third track 50C connected to the entry of intersection hot 48 .

It should be noted that the hot exchanger 48 is equipped with an output connected to a common entrance channel 32 and common 34 separate willing, in the example, downstream of the cold exchanger 42 and pump 44.

The circuit 26 exhaust recirculés includes 52 ways to bypass the second part 30B of the main intersection.

The circuit 26 exhaust recirculés also includes a valve 54 to three lanes forming means for distributing gas recirculés between the second part 30B of the main intersection and means 52 bypass thereof.

The valve division has 54 first valve 54A connected to the exhaust manifold 24, a second track 54B connected to the entrance of the second section 30B of the main intersection and a third track 54C connected to the means 52 bypass this second part 30B.

It will describe below a few examples of configurations device operating temperature 28 in referring to figures 1 to 6.

Of these figures, branches of disabled circuits are represented in traits interrupted.

The air intake is driven through the main intersection 30, at a pressure higher than atmospheric pressure, by ail turbo-compressor.

Of the figures 1 to 3, represented the device temperature 28 in a configuration adapted to cool the intake air.

The configuration of device regulation 28 shown in Figure 1 is particularly suited to rolling the vehicle at high speed. In this case, the valve division 54 is set so as to prohibit the return of exhaust in the circuit for admission. There is therefore traffic exhaust recirculés nor in the second part 30B of the main intersection in the means nor bypass 52.

The means 36 air distribution of admission are set so as to make contact channels 32 or 34 and separate liquid-cooled with airflow admission maximum crossing zones Z1 and Z2 of the first part 30A of main intersection. The pump 44 circuit cold 40 is activated to enable the flow of coolant channels in common and 32 separate 34. The valve 50 distribution coolant is regulated so as to prohibit the movement of fluid from the circuit in 46 hot main intersection 30.

In the case of Figure 2, the valve 54 distribution exhaust recirculés is set to allow the passage of these gases in the only ways to bypass 52. The exhaust recirculés, not only through the second part 30B of the main intersection, are not cooled.

The configuration of device regulation 28 shown in Figure 3 is particularly suitable for rolling the vehicle in the city. In this case, the valve 54 distribution of gas recirculés is set so as to permit the passage of these gases in the second section 30B of the main intersection. The exhaust gases recirculés therefore is cooled by passing through the main intersection 30.

Figures 4 to 6 illustrate the device temperature 28 in a configuration adapted to heat the air, but particularly in a regeneration of the particulate filter 20.

In the case of Figure 4, the pump 44 circuit cold 40 is disabled. The valve 50 distribution coolant is set to allow the flow of coolant circuit in the hot 46 and the common channel 32. The circulation of liquid coolant through the cold exchanger 42 and 34 separate channel is prohibited.

The fact that the circuit hot 46 is connected to part ways of channelling coolant in the main intersection 30, namely that in the common channel 32, will reduce the response time of device regulation 28 when you want to return to a functioning configuration adapted to cool the intake air. Moreover, it should be noted that the common channel 32 is adequate for the heating power usually required.

The means 36 air distribution of admission are set so as to direct the majority of airflow for admission into the first zone Z1 of the first part 30A of the main intersection in which spans the canal common 32 connected to the circuit hot 46.

The valve 54 distribution exhaust recirculés is set in a configuration similar to that shown in Figure 1.

In the case of Figure 5, 54 valve distribution exhaust recirculés is set in a configuration similar to that shown in Figure 2.

In the case of Figure 6, 54 valve exhaust recirculés is set in a configuration similar to that shown in Figure 3.

The exhaust recirculés through the second part 30B of the main intersection are cooled by heat exchange with the coolant circuit hot 46, the temperature of the liquid coolant is lower than the high temperature exhaust recirculés.

On the figure 7, it represented a device temperature 28 according to a second embodiment of the invention.

In this case, the main heat exchanger 30 includes 56 of pipeline means a fluid said very cold for heat exchange with at least one fluid calo-regulate among the intake air and gases d 'exhaust recirculés.

The means of channelling very cold fluid are connected to a circuit 58 fluid said very cold thermally coupled to a heat pump 60 of conventional type.

The heat pump 60 includes a circuit of 62 refrigerant, such as compression, extracting calories a cold source 64 for transferring at least partially to a hot spring 66.

The sources cold hot 66 and 64 are connected together by a compressor 68 and a valve relaxing 70.

The cold source 64 includes a heat exchanger 72 refrigerant / coolant very cold, said evaporator.

The hot spring includes a heat exchanger 74 refrigerant / air, said condenser.

The circuit 58 of fluid can very cold, if necessary, to accelerate the cooling of the intake air through the main intersection 30.

Of course, the temperature control device 28 may be settled in configurations intermediaries other than those described in particular reference to the figures 1 to 6.

The means 36 air distribution of admission, 50 of the valve distribution of liquid coolant and the valve 54 of gas distribution recirculés can be resolved in various positions allowing a precise and effective regulation of the temperature of the mixture admission including air intake and exhaust recirculés.

The invention is not limited to the modes of execution described above.

In particular, the circuit 12 air intake could be equipped with electrical resistances involved in heating the intake air or replacing the circuit hot.

Indeed, a very cold season, all turbo-compressor being at the judgement, the temperature of the intake air arriving at the main intersection is relatively low.

The electrical resistance can be heated air intake if it is necessary to regenerate the particulate filter while the temperature of liquid flowing through the hot circuit is low (as is the case in start-up phase of the combustion engine internally).